McCOLLOUGH

Depreciation in Factories

Economics

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DEPRECIATION IN FACTORIES

BY

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A. B. Tarkio College, 1908

THESIS

Submitted in Partial Fulfillment of the Requirements for the

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IN

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Elzy Vern McCollough

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DEPRECIATION IN FACTORIES

Section I

Introduction

Depreciation is a subject which has come to the front in the last few years as an essential element in accounting. This is due to the laws of many states regulating the accounts of public utilities and to the economic changes in industrial plants. The industrial plants of former times were owned and controlled by one or more persons, while to-day capital is centralized in large industries owned not by one person, but perhaps by hundreds. These large industrial plants which are owned by hundreds of people are managed by one or two persons and these persons are supposed to see that the capital investment is kept intact and that the stockholders and bond holders are given justice in regard to profits and the upkeep of the plant. It is more necessary now than in former time because the stock of a company is constantly changing hands. If the capital assets of the company are allowed to depreciate it causes a hardship upon those buying the stock, for they think that they are buying stock of a plant whose assets have been kept intact and whose standard of efficiency has been retained, but they are not getting the full value, because a part of the capital investment has been returned to the former stock holders in the form of dividends, as a result of the failure of the managers to consider depreciation.

The bond holders and stockholders have a right to demand that the officers of the company consider depreciation and make adequate provision for it in order that the wasting assets of the company may be kept up and that the efficiency of the plant be maintained.[1]

The officers of industrial plants are recognizing the importance of depreciation on fixed assets as an operating expense and the need of a systematic method of providing for a reserve or reserve fund in order to have the funds to replace the different units of a plant when they are discarded.

They recognize also that it is necessary to know the exact amount of depreciation each year in order that the true net profits for the year will be given. It is a part of the operating expense, so must be deducted before the profits can be stated.

W. M. Stewart in his report on Manufactures in the Eleventh Census shows that even the Census Report is not true as to the net profits, for the report does not include depreciation as an element of cost. He states, "The general summing up for all industries shows the total cost of \$100 worth of product to have been \$86.17 of which miscellaneous expenses formed \$6.73, wages \$24.76 and materials \$55.08, and it is explained that the remaining \$13,83 cannot be accepted as the profits or earnings for capital, because the cost reported does not include cost for depreciation of plant."[2] So the census reports have failed to consider depreciation

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1. H. Erickson, Depreciation,- p. 2
2. American Economic Association, Federal Census, New Series, Vol 2, - p. 313.

in the past and by failing to do so their reports of profits for every $100 worth of product is not true.

Business firms, corporations, public utilities, and others have failed in the past to make allowances for depreciation, but they are now coming to realize the importance of this expense.

It is not the intention here to show the effects of non-consideration upon the rates and profits but to show what depreciation in factories is, the necessity of considering it, what must be considered before depreciation is figured, the methods of handling depreciation on the books of a firm and the different methods of figuring or estimating depreciation.

Section II

Definition and Explanation of Depreciation

"Depreciation is a fall in exchange value of wasting assets figured on the basis of cost expired during the period of operation in seeking profits, increase or other advantages. The fall in exchange value of any wasting asset may be from one or more of the following causes; wear, tear, age, decay, expiration of time, inadequacy and obsolescence. By the use of the term wasting assets is meant all forms of assets which fall in value when used for the purpose of receiving profits, increase or other advantages, other than, by purchase, exchange, and sale."[1]

There are two general classes of wasting assets, one being represented by some tangible piece of property, some physical asset, which gradually wastes away in the operation of seeking "profits, increase or other advantages." The other class consists of those assets which are not represented by a tangible piece of property, but are represented by a fund and are called intangible assets. An example of the first class is that of a machine which is used for the purpose of making shoes and which gradually falls in exchange value or is worn out due to its use in the seeking of profits by the making of shoes for sale. The second class may be represented by that sum which a street-railway company would pay for a franchise; that is the right or privilege to place the street-

1. P. D. Leake, Depreciation and Wasting Assets, -p. 1.

car tracks in the streets of a city for the purpose of carrying on a public service transportation business for profits. This franchise is not represented by any tangible piece of property but is represented by that sum which the company paid for the privilege of using the streets for carrying on a business within that city.

Land is not generally considered as a wasting asset because in all cases it does not fall in value as a result of seeking profits by its use. There is just as great a chance for land to gain in value through its use as there is for it to fall in value. Therefore because it does not gradually waste away through use it is not held as a wasting asset. Another form of assets that are not considered as wasting assets are stocks, bonds, and other like securities; for in most of cases they are purchased or secured for the purpose of obtaining a profit in the form of dividends, interest, or from an advance in their exchange value.[2]

Raw material and goods on hand held for the purpose of manufacturing some article or for sale are not wasting assets according to the explanation given above, neither are mined minerals and harvested crops, for they are held for the purpose of either manufacturing some article or for sale and do not fall in exchange value during any period of use in "seeking profits, increase or other advantages." [3]

The mines from which the minerals and other products are secured, when used for the purpose of seeking profits

2. P. D. Leake, The Accountant, December 27, 1913 -p.940
3. Ibid -p.940

are considered wasting assets when being operated, because they gradually fall in exchange value during the period of operation or in other words there is a gradual decrease of the total amount of that from which the profit is to be made.[4]

The term depreciation is very misleading for it is not only used to denote the fall in exchange value of some wasting asset, but is used to express any decline or fall. It may be the decline of some person's reputation as a business man or of the morals of some one. The common reference is "A great depreciation of the standards of morals among the people," and the term is also used in speaking of the fall in value of stocks, bonds, etc. Mr. Leake uses a term when speaking of depreciation of wasting assets that will not be confusing, which is "Expired Capital Outlay", so making a distinction between the different classes of assets in regard to depreciation.[5]

According to the definition given at the outset for depreciation, it may be of two classes, physical and functional.[6] Physical depreciation is the fall in exchange value caused by wear, tear, and decay, all of which takes place in any machine or building which is used. There are very few machines or buildings that will not waste away and at last become useless if used, even if great care is taken of them and repairs are made when needed. This being the case it may be said that physical assets used for the purpose of seeking profits can not be capitalized with permanent certainty.

4. George C. Shad, Public Service, July 1913, -p.17
5. P. D. Leake, Depreciation and Wasting Assets, -p.12
6. G. C. Shad, Public Service, July 1913, -p.17

Functional depreciation is a fall in exchange value due to time, inadequacy, or obsolescence. Machines very often become inadequate because of the growth of the business, the great demand for that which is being produced, and it becomes necessary to discard the machine not because it is worn out but because it is not capable of doing the work which is now demanded or sought from it. Obsolescence is the result of inventions. No one knows when some new machine will be invented that will be capable of doing the same work that four or five machines are now doing and by the use of the one new machine and the discarding of the four they are not only able to produce the same quantity of goods, but at a far less expense, so paying the company for the loss involved in discarding the machines that were not worn out.

Mr. Leonard Metcalf gives three classes of depreciation, physical, functional, and contingent. In the contingent depreciation Mr. Metcalf includes all other losses in value of the wasting assets that cannot be logically included in the other two classes. He says, "This should include cost of locating street mains of a water plant, the sudden bursting of some pipe, the lowering of some grade, and any accident due to unforeseen and reasonably unpreventable conditions, and that a special account for contingent depreciation should be kept separate from the physical and functional depreciation, not only that the necessary amount may be the more accurately determined but that when this fund has reached what may appear to be or later be determined to be a reasonable amount, no further contributions should be made until a draft has been made against it,

reducing the remaining balance below a safe figure."[7]

Mr. Metcalf might as well include contingent depreciation, as he explains it, with that of the functional, that is as to the method of handling it upon the books of the firm, for functional depreciation is nothing more than a contingent depreciation, since no one can say when any part of a plant will become inadequate because of a great increase in business or when some part of the plant will become obsolete because of some new invention. Functional depreciation is generally due to unforeseen and reasonably unpreventable conditions. It is unforeseen and unpreventable because a person is not able to look into the future and estimate how long it will be before a machine will become inadequate and if it could be so, the estimated life of the machine would be shortened accordingly. It is possible from past records and experience to make a very close estimate as to the life of some machine and the amount of physical depreciation that will take place during the estimated life from use, but there are no records that would be of any great advantage by which a person could estimate contingent or functional depreciation. Past experience cannot be relied upon, for it cannot be said exactly whether there will be as great a growth in this business as there has been in others of similar character in the past or that there will be as great advancement along the line of inventions which will affect the plant under consideration.

If contingent and functional depreciation are considered

[7] Leonard Metcalf, Depreciation in Water Works, Public Service, March, 1913.

in the same manner as that of physical depreciation, writing off each year a set amount to profit and loss, an expense or a loss is then considered which has not taken place and in fact may never take place and if it is considered in the same manner as physical depreciation, counting it off to loss, it causes an untrue statement of the net gains for that year. In physical depreciation the loss has taken place before the amount is written off, it has been consumed in the production of some article or in the performance of some service so that it is a part of the operating expense.

The only reasonable way to consider contingent and functional depreciation is to create a reserve or a reserve fund from the surplus of the business each year and when the unexpected loss does occur there will be at least a part of the needed sum on hand to replace that part which has been discarded. If there is not enough in the reserve or reserve fund to replace the discarded machine, the balance may be written off during the following years, but to write it off at the time at which it occurs would perhaps place too great a loss upon that year. It cannot be said that it should have been considered as an expense or loss to past operations for the loss did not take place then or was not expected; it is more of a loss to the future than to the past production, because to continue producing, this part must be discarded and a new part purchased.

The size of this reserve or reserve fund will depend upon the nature of the plant and upon the judgment of those in control. When according to the judgment of those in control

the reserve has become large enough it is best to cease placing funds to the account until there has been some draft made against the account.

Section III

Necessity of Providing for Depreciation

It is often claimed by business men that depreciation should not be considered because the appreciation of the fixed assets more than makes up the loss through depreciation, so it is not necessary to provide for it. The knowledge that a part of the property is worth more is not a sufficient excuse for assuming that a profit has been made upon that part. In fact no profit can be considered or should be considered until the actual sale has taken place and the profit has been realized. Therefore an increase in value should not be permitted to offset the proper charges to expense, the elimination of which would increase the profits.[8] A wasting asset is purchased by a company for the purpose of making a profit through the production of some article and not by the sale of the asset.

Others say that they do not have depreciation because of the care they have taken of their plant, that they have made the repairs when needed, thus keeping the plant up to the same standard as when first purchased. This is not logical for there are few plants that can be kept up by repairs so that they are as good as new. If this could be done the plant or machine would have an indefinite life, but this is something which very seldom happens.[8] The repairs may be made at the right time and often, so that the life of the machine

8. S. F. Racine, Accounting Principles, -p.116.

is extended many years, but there is almost sure to come a time when it will not pay to make further repairs upon the machine. Then the machine is discarded and a new one is purchased in its place; and if the new one is bought and depreciation has not been considered on the old machine how then is the money to be secured for the purchase of the machine? The company may have enough money on hand to buy one machine, but if necessary to buy several at one time it will then be necessary to negotiate a loan in order to secure them.

If the machine when it becomes useless is charged off to loss in the period in which it is discarded the loss is greater than it should be for that period, causing a misleading statement not only of that year's business but of former years.

To illustrate this with an example; a factory has purchased a $2,000 machine. This machine is used for the making of shoes. With care and proper repairs the machine lasts twelve years and is sold for $200. Now that means that during the twelve years $1,800 worth of machinery has been consumed in the making of shoes. This $1,800 worth of machinery has not been consumed in the year in which the machine was discarded, but during the twelve years, and this being the case the $1,800 should have been charged to the cost of manufacturing the shoes during the twelve years. If it has not been considered during the twelve years it has caused the net profits for those years to be inflated. The factory has not known the exact cost of making the shoes during the past twelve years and has been

led to believe that they were earning more than they were.

This fall in exchange value of the machine each year should be considered as an expense to that year in which it took place just the same as the wages paid to the men that operate it, the rent paid for the use of the building, or interest paid on borrowed money. Suppose that the machine had not been bought but had been rented for twelve years at the rate of $150 a year, the firm would not wait twelve years before considering this $150 each year as an expense. They would consider the $150 paid as rent a part of the operating expense for that year. This being the case, the gradual depreciation in exchange value of the machihe each year must be considered as an expense just the same as the rent paid for the use of the machine.[9]

It should be the desire of every business man to know the exact cost of conducting his business each year. This is desired in order that he will be able to compare his present expenses with that of former years and to know whether the profits are increasing of not.

If the worn out asset remains on the books of the factory as an asset it gives a mis-leading statement of the assets of the firm. The assets on the books of the factory appear to be greater than they really are and so cause what is generally called "dead capital", capital which is of no benefit or aid to the business in securing profits. In order to secure a fair rate of return upon the capital investment, as the books would then show it, there would be an advance

9. H. Erickson, Depreciation, - p.10

in the net earnings.[10]

This is noticed more in public utilities where the rate of returns upon the investment is regulated and controlled by the various public service commissions. If the worn out asset remains upon the books of the firm it means that to receive a fair rate of return upon the amount of investment as shown, it will be receiving returns upon "dead capital," upon capital which is of no benefit to the company or to the community. If the utility is allowed a fair rate of return upon this capital it means that it is doing an injustice to the public by making them pay for service which they are not receiving. For this reason, the commissions generally speaking have based rates only upon the value of existing property without regard to the dead capital which may be carried upon the books.

If the "dead capital" continues to increase the company will probably have to reorganize or pass in the hands of a receiver, because their resources have become nearly exhausted and they have no provision for replacing them except through an increase in capitalization, which is very difficult for a factory under such conditions. They have been paying out in dividends cash that should have been kept in the business to replace the wasting assets.

The factory that has not considered depreciation as an expense and has not created a reserve has been returning to the stockholders a portion of their investment, for if the factory had reserved a certain percent, each year of their

[10] 10, H. R. Hatfield, Modern Accounting, -p.122.

profits for replacements the stockholders would not have received as great dividends and they would have had the funds to replace that which had been consumed in production.

If a plant has depreciated $5,000 during the year and this has not been considered a part of the operating expenses the profits will be recorded as $5,000 larger than they really are and if this is divided up among the stockholders as dividends it means they are receiving a part of their investment back in the form of dividends.

A factory that fails to consider depreciation is doing either one of two things, it is consuming the investment and receiving only a fair rate of return or it is getting a fair rate of return plus a part of its investment. In order then to keep the investment intact it must charge depreciation as an expense and create a reserve for the purpose of replacing that part of the investment which has been consumed in production.

The tendency where depreciation is not considered and the repairs and renewals are expected to keep the investment intact is to gauge the expenditure for such work according to the profits for that year. During poor years when profits are small many repairs and renewals are dispensed with and the final result is that the future years will have to bear this expense; and the failure to make the repairs at the proper time greatly increases the depreciation, thus causing a greater expense to the future years and causing the profits to be incorrectly stated from year to year.[11]

[11] S. F. Racine, Accounting Principles, -p.116.

Some factories in order to make as good a showing as possible do not consider depreciation, thus increasing the profits. It very often happens that a factory is run down when taken over by a new manager and the tendency is to increase the capital investment with the amount expended for renewals and repairs, for they claim that these repairs and renewals should have been made by the former manager and should not be charged against the present period. This method also causes a misleading statement of profits and also of the real value of the wasting assets of the company.[12]

A factory may not consider depreciation and so inflate the profits, making the business have the appearance of being in a very prosperous condition, causing people to buy stock which is for sale or to make a loan to the factory upon the fact that the books show a profit from the year's business. All persons should first find out whether the company is making adequate provision for depreciation and the manner in which it is handled, and if it is handled in the proper manner they are then able to know whether the company has taken the proper care as to keeping up the capital investment or whether there is any great amount of "dead capital".

Different states recognize the importance of depreciation in public utilities and the necessity of considering it as a part of the operating expense in order that they may know the exact operating cost so that the rates charged to the public may be adequate for carrying on the operations of the utility, that the standard of efficiency may be maintained and that

12. S. F. Racine, Accounting Principles, -p. 116.

the capital investment may be kept intact. They recognize the mistakes which have been made in the past in not considering depreciation and the failures which have resulted from the nonconsideration. Most of the Public Utilities Laws have made provision in regard to depreciation and the manner of handling it upon the books of the company.

In the Public Utility Law of Wisconsin the Commission of that state has recognized the fact that all public utility property depreciates in value and efficiency and that this loss from depreciation must be made good by renewals of the property if the investment is to remain intact and the efficiency is to be kept up. It also recognizes the fact that depreciation is an operating expense and that it should be borne by the consumer in the form of rates high enough to cover the loss.[13] If the property of public utilities depreciates the property of factories must also depreciate and is a charge to operating expense.

The law does not state what method of determining the amount of depreciation for each year shall be used. It says that "the commission shall ascertain and determine what are the proper and adequate rates of depreciation of the several classes of property of each utility." According to this any method of handling depreciation will be right as long as it provides an adequate amount and is set aside in a depreciation fund.

It might be well to give some of the decisions of the courts in regard to depreciation to show that they recognize

[13] H. Erickson, Depreciation, -p.51.

the fact that depreciation is an expense and should be considered as such before the net profits can be given.

"Depreciation must be deducted to determine the net income -- New York courts in Franchise Tax Cases. Case of People ex. rel. Jamaica Water Supply Company V. Tax Commissioners. The net income of a corporation for dividend purposes cannot be determined until all the taxes, depreciation, maintenance and up-keep expenditures have been deducted. Otherwise the dividend is not paid from the earnings but by a depreciation of the capital account. To earn a dividend and be honest with itself, its stock-holders, its creditors and the public it has to serve, a corporation cannot distribute earnings at the expense of its capital. If a corporation, year after year, should distribute its earnings, after deducting expenses making no allowance for taxes or the replacements or up-keep requirements of the plant, in time the entire capital would be gone by the payment of unearned dividends. The value of the property of the company, especially its franchise and goodwill, cannot be ascertained until the franchise tax and all the other taxes and proper replacement or up-keep fund has been deducted from the current earnings. If this is not done, an attempt to arrive at the value of the property, based upon its net earnings is deceptive....The plant has expensive pumps and machinery which is liable to serious depreciation by use, and in time to actual destruction, so that prudence would require that each year a certain reasonable sum be laid aside as a replacement or up-keep fund for such contingencies as are not covered by the ordinary maintenance charges. If such a fund is

not maintained the property is being robbed for the purpose of paying the dividends or exaggerating its paper value."[14]

"In Des Moines Water Co. vs. City of Des Moines, the master included an allowance of $15,000 a year to cover depreciation on the sinking fund basis. The allowance amounted to one per cent, on the estimated present value of the physical property subject to depreciation".[15]

These cases show that there is a general belief that depreciation is an expense and it is necessary to consider as such in determining the cost of operation.

[14] R. H. Whitten, Valuation of Public Service Corporations, -p.416.
[15] Ibid, -p.428.

Section IV

Conditions that must be Considered before Depreciation can be Charged.

There are many conditions which must be considered in connection with a manufacturing plant before depreciation can be estimated. One must know all that is included in the original cost of the plant, the probable life of the different units, the extent of the repairs during the life of the machine, the care taken of it, the scrap value at the end of its useful life, the possibility of it becoming obsolete and inadequate and the possibility of the public requiring a change in the form of the wasting assets.

It is the aim to explain fully the need of careful investigation of each one of the main conditions which will have some influence upon the amount of depreciation that shall be charged each year.

The original cost of a manufacturing plant includes not only the cost of the physical assets, but also the cost of promotion and organization, cost of charter, interest and taxes during construction, discount on bonds sold and in fact all expenses that are necessary to place the plant in condition ready for operation.[16.]

By cash is meant the actual outlay of money or its equivalent. By actual cash then, the actual outlay of money or its equivalent that was used to place the plant in running con-

16. H. Erickson, Valuation of Public Utilities, -p.7.

dition or ready for operation.

The work of promotion and organization is the assemblying of the people together and interesting them in the proposition of starting a factory and organizing a company, securing of the charter from the state, making the necessary arrangement for securing the capital, letting contracts, securing plans and specifications for the plant and is in fact the looking after the entire work of getting the factory started. Promotion and organization requires both time and labor and the service of professional men, such as legal advice, and service of accountants and engineers. When all this expense is necessary for the organization of a company and the company cannot be organized without this cost then it is a part of the cost of the plant. For a plant to charge such items as a part of the cost when it could have been organized without it, it is not a part of the cost of the plant but is a charge which is commonly used in stock watering.[17] It must be remembered that this cost cannot be depreciatied in the same manner in which the physical assets are unless at certain periods in the life of the plant it is necessary to expend money in the same manner, again, and if not it should be written off in a manner that is thought best by the persons in control. The cost of organization needs not be paid in cash but can be paid in stock of the company which is considered the equivalent of cash. The discount which is given on stock is a part of the cost of the plant, for to organize a company it is very often necessary to sell the stock

[17] H. Erickson, Valuation of Public Utilities, -p.7.

below par so as to interest investors. It very often takes this discount to make the organization of the factory possible.

A factory to become a corporation must receive its power or right to do business in the form of a charter from the state. Under the cost of the charter should appear all expenses incurred in the securing of it, but nothing more.

It has been customary with some factories to capitalize the charter at a larger sum than it cost them, because of the great value which it is to them in conducting their business. This is not right, for the additional value which they have placed upon it is not a part of the original cost of the plant, It is true it may have a greater value than the original cost if the plant is to be sold, but to place a greater value, for the sake of increasing the assets of the firm is not right in principle. To capitalize the actual cost of the charter is legitimate as it is the same as money invested in a physical asset, for to conduct the business it is necessary to have the charter. This cost gradually falls in value as the years go by and it is necessary to depreciate it and to create a reserve or reserve fund so that the company will have the necessary funds on hand to secure a new charter when the old one expires.

Goodwill is considered a part of the original cost of a competitive plant which has been purchased, but it is generally considered that there cannot be goodwill in a monopolistic plant, for goodwill is based upon competition and freedom of patronage. Lord Eldon said "goodwill is nothing more than the probability that the old customers will resort to the old

place." So that the term is inappropriate where there is no choice of patronage.[18]

Judge Taylor in arbitrating the Cleveland Traction controversy in which no allowance was made for goodwill, explained his view as follows: "I allow nothing for goodwill. A street railway company which has a monopoly and especially if it has a franchise value remaining can have no goodwill value."[19]

In the purchase of a business the amount which is paid over and above the original investment is considered goodwill, it is buying the probability of the old customers' returning to this place.[20] It is a necessary cost in order to secure the business. It is a part of the original cost which does not depreciate in the same manner as a physical asset does. The only way by which good-will might depreciate would be through the decline, or falling off of the business of the company through the loss of the customers. So in considering the original cost of the plant for depreciation purposes this cannot or should not be depreciated.

Some firms think that it is advisable to gradually write off the sum which is placed to goodwill account, but this does not mean that the goodwill has fallen in exchange value, for it remains the same so long as the business continues to be in as prosperous a condition as it was when purchased.

The capitalization of all expenses of the plant ceases as soon as the plant is put into operation. Some claim that the great cost of advertising, of soliciting trade, free demon-

[18] H. Floy, Valuation of Public Utilities, -p.139
[19] Ibid - p.138
[20] H. R. Hatfield, Modern Accounting, -p.109.

strations and free service should be considered a part of the original cost of a new factory, but it is not logical to so consider it. This great cost of securing business for a new firm needs not be charged off to profit and loss the first year of operation, but may be distributed over a number of years, because it is a benefit to the business for more than one year; it is a benefit for several years. The main reasons for not considering it as an expense to the first year of operation is that in a new factory the income is very often not great enough to pay all the expenses which are incurred in starting the factory; and the benefit of this expense lasts longer than one year. One of the most difficult problems in connection with depreciation is that of estimating the probable life of the different classes of physical assets which go to make up the plant. The life of any machine or building depends upon the conditions under which each class of property is used, the manner in which it was built, the material of which it is composed, the care which is taken of each part and whether the repairs are made when needed.

In former times it was a difficult matter to make an estimate of the probable life of the different uhits which go to make up a factory because records had not been kept and a careful study of the life of machinery had not been made. Today the probable life may be estimated from past records of factories under similar conditions. Many life tables have been prepared in regard to all classes of machinery and by the use of these and the comparison of conditions under which they have been used one is able to arrive at a very accurate estimate of the probable life of the machine or plant as a whole. In mak-

ing use of these past records and life tables one must remember that there are no two plants operated under exactly the same conditions, so one must choose only those that are nearly the same as the one upon which the estimate is being made.

The life of any physical asset depends upon the conditions under which it is used. A machine will last much longer when operated by experienced men, than when used by ignorant and inexperienced persons. A well trained man learns to know his machine and is able to tell at once when it is not working just right; and seeing this he is able to remedy the trouble. He takes pride in his machine and it becomes almost a part of him, while the ignorant and inexperienced operator is ordinarily not able to notice when it is not working as it should. Even if he does, he does not take the trouble to find out what is the matter; and continues to use the machine when perhaps it needs only to be adjusted, so causing a great wear and tear upon it. Then again he has greater breakage than the experienced operator, and every time the machine breaks it shortens the life of it no matter how well the broken parts are repaired.

Some operators are paid according to the amount of work they are able to do, that is they are paid by the piece. When this is done there is a tendency to crowd and overwork a machine, forcing it to do more than it was built for, so shortening the life of the machine. Certain machines are built to be used at a moderate rate of speed and are forced to work at a high rate because of a great demand for goods. Engines are very often used under a higher pressure than they were built for so

hastening the deterioration.[21]

A great deal depends upon the manner in which a machine or building is built. Machines and buildings used where there is great concussion will soon wear out unless there is a firm foundation, one which does not give while the machine is in use. The life of all machinery and buildings depends upon the material of which they are built, whether good or poor and the manner in which they were built, the location whether on low or high land, in a dry or damp climate, extreme cold or heat, all of these conditions must be considered in regard to depreciation.[22]

The time and manner in which repairs are made upon a plant affect ~~s~~ the probable life to a great extent. If repairs are made at once the damage is not so great but to let the repairing of a machine which is in use go for a very long time causes it to depreciate very fast. A person is liable to overlook minor repairs thinking that they do not amount to much but it is not long until these minor repairs become large repairs. It should be the aim of every manager to make all repairs at once no difference how small, in order to secure the greatest possible service and to lengthen the life of the machine or plant as a whole.

In estimating the life of any machine one must consider the number of hours it is operated at a time. Some machines are used occasionally while others are used twenty four hours at a time and as a result the machine which is operated the twenty four hours a day, week in and week out will become worn

21. E. Matheson, Depreciation of Factories, -p.38
22. S. S. Dawson's Accounts Compendium, -p.142.

out much sooner than one that is used only eight hours out of every twenty four.

The general care taken of a machine effects its life to a great extent. It must be cleaned, repaired and oiled regularly, and a frame building should be painted frequently.

The scrap value of some machines is quite high especially machines made of copper or brass while others have very small scrap value because of the material used. It then depends upon the material of which a machine is composed whether it will be of any value after it has been discarded. The machine which has become inadequate is very often sold at a very good price to a smaller factory as a secnnd hand machine.

In estimating the scrap value the cost of removal must always be considered and for that reason many machines when sold bring only enough to pay for their removal so would have no real scrap value in the figuring of depreciation.

Mention has been made before in regard to obsolescence and inadequacy in connection with functional depreciation and the best method of handling upon the books of a factory, but it seems best to elaborate a little on what has been said before. Some thought must be taken of the probability of a machine's becoming obsolete or inadequate. It always influences a person in making the estimate of the life of a machine to a certain extent.

Obsolesence is the result of some new invention while inadequacy is due to the growth of the business, it is a class of deterioration which cannot be prevented by maintenance or

repairs. It is just as hard to say when a machine will become obsolete or inadequate as it to say when there will be a fire, a flood or a cyclone.[23]

In manufacturing plants it is the investor that assumes the hazard of a machine becoming obsolete or inadequate and they should obtain a higher normal rate of profit than would prevail were it not for the risk. The consumer in the long run should pay for all the replacement as it is a necessary part of the cost of manufacturing.

In a competitive factory they must adopt the new and cheaper methods even to a complete disposal of his plant even if it is not worn out or have its business taken from it by the more progressive competitors.[24]

The best methods of handling this form of depreciation has been given before in this article so it is not necessary to make any further comments.

23. R. H. Whitten, Valuation of Public Service Corporation, -p.383.

24. Ibid -p.384.

Section V

Different Methods of Providing for Depreciation

It is a very difficult problem to determine what is the best method of finding the amount that should be set aside annually to cover the loss from depreciation. Six methods of figuring depreciation and of equalizing the cost through the estimated life of a machine are: Straight Line, Sinking Fund, Diminishing Value, Annuity, Wm. Cole, and Revaluation. Another method is also used here to show the effects of interest upon depreciation, which is called Compound Interest Method. In explaining these methods the cost of one machine will be used to show the advantages and disadvantages of each method. The case to be used is that of a machine that cost $2000 new, whose scrap value is $200 and whose estimated life is twelve years.

Straight Line Method.

The Straight Line Method assumes a uniform and constant reduction in the value of the asset during its estimated life and consists in placing to the machinery depreciation account an annual sum proportional to the useful life of the asset.[25] That is, from the cost of the machine the scrap value is deducted and the remainder is divided by the assumed number of years the machine is estimated to last. This then gives the sum to be set aside annually which will in the assumed number of years provide a sum sufficient to replace the machine at the end of

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[25] S. S. Wyer, Regulation, Valuation and Depreciation of Public Utilities, -p.121.

its useful life. "This method is used more than any other because of its simplicity and ease in handling."[25] In the example which is to be used the assumed life is twelve years, 1/12 of the difference between the original cost and its scrap value would be charged to operating expense and the Depreciation Reserve credited for a like amount, or it may be the sum is withdrawn and placed in the Sinking Fund Investment Account, and then both the accounts would appear upon the book, the Depreciation Reserve being a credit and the Sinking Fund Investment account a debit. One twelfth of $1800 is the sum to be depreciated annually, which is $150 (or eight and one third percent. of $1800 is $150). At the close of twelve years there will be a total of $1800 depreciated and the $200 balance is the scrap value which was the estimate at the beginning.[26]

This method does not take into consideration any interest which may be received if the sum is placed in a Sinking Fund Investment Account, and if any interest is received it is placed to the Profit and Loss Account so reducing the annual expenses of the company.

There are both advantages and disadvantages in connection with this method. By some it is favored because the sum charged off each year is uniform, easy to figure and estimate, and because in a new business the expenses are so large the first few years that it is hard to pay all expenses and so does not make such heavy charges at the first as some of the other methods that will be discussed later. There are others that say it is

[25] S.S.Wyer, Regulation, Valuation and Depreciation of Public Utilities, -p. 121.

[26] Ibid, -p.127.

best to charge off more depreciation during the first part of the life of the machine when the cost of repairs is not so great and to deduct less during the later years when repairs are great and become a burden, so keeping the annual expense at as near a constant figure as possible.[27] This latter idea seems to miss the main purpose of depreciation which is to charge off as nearly as possible the exact amount of depreciation each year to operating expense whether it be great or small.

Sinking Fund Method

The Sinking Fund Method consists in setting aside each year during the life of the property a fixed sum which, with the accrued interest compounded either annually or semi-annually, will produce a sum equal to the original cost less its scrap value. The annual payments by this method will be less than that of the Straight Line Method for the accumulation of interest will make up the deficiency.

The life of the machine is twelve years, the amount to be reserved during that time is $1800; it is then necessary to find a sum which, set aside annually each year at compound interest, will produce the sum required. Suppose that the rate of interest is 5%; it is found from annuity tables that $113.10 set aside annually at compound interest will produce the sum required. [28]

The amount which is written off each year will depend largely upon the rate of interest at which the fund is assumed

[27] D. S. Kimball, Principles of Industrial Organization, - p.155

[28] Aside from reference to annuity tables the easiest method for finding what sum set aside annually each year at compound interest will produce the required sum at the close of twelve years is given by Wm. Cole, in his book on Accounting and Auditing, -p.269.

to accumulate. The higher the rate of interest the smaller will be the annual sum charged as operating expense for depreciation. It has however, been proven by experience that the sinking fund will not accumulate as rapidly as the tables estimate, for there are usually withdrawals at different times which decrease the rate at which the amount is compounded.[29]

It is also hard to estimate what will be the annual rate of interest which will be received upon the sinking fund, the rate may vary considerably in forty years so it is best to place the rate low enough to be sure that the required amount will be on hand at the time when it is needed.

For any factory which is able to make large profits from its investments the Sinking Fund is a very poor method to use. The rate of interest received upon the fund is generally quite low and very often the company is making 10, 12, or 15% upon its investment, so that by placing the sum in a Sinking Fund it is losing money. If the rate is 5% and they are able to make 10% on their money invested they are losing 5% each year because of this, a sum which in a few years would amount to a large sum. It seems that in a case of this kind that it would be best to have just the Reserve Account. Then the money still remains in the business and if the money is so tied up in the business that it is not possible to use it in purchasing the new machinery when needed it still would pay them to let it remain in the business if it is making from 6% to 12% or 15% and borrow the needed sum at a low rate of interest.

29. R. H. Whitten, Valuation of Public Service Corporations, -p.334.

The Sinking Fund is a part of the total capital necessary to carry on the business and there seems to be no reason why a part of the total capital should be set aside to accumulate at a lower rate than that earned upon the entire investment. The entire plant is a unit and the profits, whatever they may be, are the earnings of the entire investment. One part of the investment should not be earning a certain percent and another part a lower percent, when the total could be earning the same higher rate.[30]

In many cases in connection with public utilities the Sinking Fund Method has been rejected by the courts. In the Louisville Telephone Rate Case, District Judge Evans fixed the annual rate of depreciation at 7%, but rejected the sinking fund theory of accumulation.[31] In regard to the matter he made the following statement: "Of course our estimate could not be based upon the proposition that the per cent. set apart to cover depreciation would be deposited in bank or loaned out from year to year so as to accumulate and be on hand at the end of 14 years, and to be then used to construct an entirely new plant, and so on from period to period. In such a case the public would not only have a service that would progressively grow worse until its operations ceased altogether, but it would thereafter get no service at all until a new plant replacing the old could be completed and put into operation. The question rather has been, What does experience show to be the proper average per cent. of annual earnings which the company should expend in order to insure that its plant will be as good as it

30. Engineering News, Vol. 69, May 8,1913. -p.946.
31. Cumberland Telphone and Telegraph Co., vs. City of Louisville, 187. Fed. 637,655 decided April 25,1911.

now is, and in the meantime render to the public that good service which its duty to the public requires?"[32]

In this case Judge Evans seems to be looking at depreciation from the wrong viewpoint. He is looking at the plant as a whole with the idea that it is not able to withdraw any of the money from the sinking fund until the entire plant has become worn out. That is not the idea in regard to the Sinking Fund Method. In a large factory each unit may differ as to its life, there may be four parts or units which will last five years, another ten years, two for fifteen years, three for twenty years and one for fifty years and in that case it is best to group the different units according to their life upon the books of the company and when one or more machines have become worn out there will be the required amount in the Sinking Fund Investment Account to replace them and so on indefinitely. At the close of five years there should be the total cost of the four machines, plus the estimated amount that the other units have depreciated in the Sinking Fund Account, so that when the sum which is needed to purchase the four units is withdrawn there remains in that account the amount by which the ten, fifteen, twenty and fifty year units have depreciated. If this is done the efficiency of the plant is kept up and there is not the loss of service or time which is spoken of by Judge Evans. No manufacturing plant would think of handling the Sinking Fund in the manner which is intimated in the above case. It cannot be conceived of a large factory doing so; and it could not, for it would have to

[32] R.H.Whitten, Valuation of Public Service Corporations, -p.415.

close down long before some parts had become worn out, for it would not be able to continue production with some of the machines worn out. With the Sinking Fund Method they are supposed to withdraw from the fund the necessary amount to replace the worn out units as they are needed.

Form I

Years	5%	3%	Showing Differences in Value
1	2000	2000	
2	1886.90	1873.16	13.74
3	1768.15	1742.52	25.63
4	1643.47	1607.96	35.51
5	1512.56	1469.36	43.20
6	1375.11	1326.60	48.51
7	1230.79	1179.56	51.23
8	1079.25	1028.11	51.14
9	920.13	872.12	48.01
10	753.05	711.45	41.60
11	577.62	545.96	31.66
12	393.42	375.51	17.91
	200.01	199.95	

Showing how the difference in rate of interest affects the present value of the asset. Cost new $2000. Estimated life twelve years. Scrap value $200. Total amount of depreciation during the twelve years $1800.

Form one shows the difference in the supposed or estimated value of the machine at the close of each year when the Sinking Fund is invested at 3% and 5%. If the amount of Depreciation should be deducted from the assets each year it is found that under the 5% rate the balance is always larger at the close of each year than by estimating that the fund receives only 3%. In the comparison of two different balance sheets of two plants operated under the same conditions one cannot make a correct statement as to the real value of the assets unless the rate of interest to be received upon the sinking fund is at the same rate. Take the seventh year: at 5% the balance is $1230.79, and at 3% it is $1179.56, a difference of $51.23 upon a machine which cost $2000. According to this, one machine is worth $51.23 more than the other and they have been used in the very same manner. So for the purpose of comparison of the present value of two machines in different plants the rate of interest received upon the Sinking Fund will have a great influence.

Form II

Years	5%	3%	Showing Differences in Charges
1	113.10	126.84	13.74
2	118.75	130.64	11.89
3	124.68	134.56	9.88
4	130.91	138.60	7.69
5	137.45	142.76	5.31
6	144.32	147.04	2.72
7	151.54	151.45	.09
8	159.12	155.99	3.13
9	167.08	160.67	6.41
10	175.43	165.49	9.94
11	184.20	170.45	13.75
12	193.41	175.56	17.85

Showing two different rates of interest and effect upon each year as to the sum to be deducted from value of asset.

Machine cost $2000, life twelve years, scrap value $200.

Form two shows the effect of two different rates of interest upon the sum which is charged off to depreciation each year by the Sinking Fund Method. The first year, considering interest at 5% and at 3%, we find that at three percent. the amount charged to depreciation is $13.74 larger than when it is estimated at five percent. and it gradually becomes smaller each year for seven years and at the close of the seventh it is only seven cents more than the 5% rate. The eighth year it reverses and the amount charged off at 3% interest rate is less than that at 5% by $3.13 and it gradually increases each year until in the twelfth year the amount charged under the 3% method is $17.85 less than under the 5% method.

These two forms are placed here for the purpose of showing the effect of high and low rate of interest.

Diminishing Value Method

The Diminishing Value Method is to charge off each year a fixed percent of the decreasing net value. This does not give a constant amount, but a gradual diminishing annual charge for depreciation. This is a method which is very seldom used and is one that is difficult to figure. The formula which is used is $R= 1 - \sqrt[n]{\frac{v_2}{v_1}}$ in which R. represents the percent of the diminishing value to be charged off annually for depreciation, V_1 equals the cost price, V_2 the scrap value, and N the estimated life of the machine. This formula is solved by the use of logarithmic tables. This formula cannot be applied where the asset does not have any scrap value, because the calculations

would involve infinity.[33]

The one main argument in favor of the use of this method is that the charge for depreciation becomes less each year, so making the charges greater at the first part of the life of the machine when the cost of repairs is small and less when the cost of repairs become greater. As repairs and depreciations are both charges to operating expense, the decreasing depreciation and the increasing cost of repairs makes a uniform charge to expense; and therefore, profits are more equally divided during the life of the machine. Against this method it may be said that for a new factory the large amount charged to depreciation the first few years would cause a burden because of the large expense at the beginning of the business when profits are small. Then also the mathematical calculation causes trouble.[34]

It is rather doubtful whether this method gives the actual amount of depreciation each year. It is hardly possible that a machine depreciates less the older it gets; the difference seems to be too large to be correct. In the example used before, the rate of depreciation is 17½% and the amount of depreciation the first year is $350. and the twelfth year it is only $41.10, it is hardly possible that the depreciation is over $300 greater the first year than the last.

There are few records of this method even being used and so is not so well known as that of the Straight Line or the Sink-Fund.

33.H. Erickson, Depreciation, -p.33.
34.H. R. Hatfield, Modern Accounting, -p.131.

Annuity Method

The Annuity Method is more complicated than any of the others. It assumes that the cost of production includes not only the cost of repairs and depreciation but interest on the amount of capital invested in the machine. Depreciation under this method is represented by a constant sum which is sufficient to write off not only the decline in value, but also to write off the annual interest charges on the diminishing value of the machine.[35]

The chief objections to this method are the marking up of the value of the asset by an allowance for assumed interest, and the complicated method of obtaining the annual charges. Few factories will take the trouble to use this method.[36]

The annual charge to operating expense is a constant sum, but a part of the charge covers the interest upon the diminishing value of the asset and as the interest is gradually decreasing, it then must be that the actual depreciation charges increase each year.

The question is why should interest be added to the diminishing value of the asset each year. Does it bring the annual charge to operating expense nearer to the actual amount than by any other method? It hardly seems possible that it would, and moreover it places a sum to the machine account as to which no correct answer can be given why it has been increased or why the interest is a gain. It is placing upon the books a transaction which has not really taken place. When

35. H. R. Hatfield, Modern Accounting, -p.132.
36. Ibid, 132.

money is invested in a machine there is always a certain risk in connection with the investment;and the money was so invested for the purpose of making a profit from that machine if it is at all possible through the production of some article. Therefore, the idea that interest in addition to profits should be received from that amount invested is wrong.

The formula given for the Annuity Method is $D= V_1 R^n - V_2 \div \frac{R_n - 1}{R - 1}$ D equals annual charges to depreciation; V equals cost when new; V equals scrap value; R equals one plus rate of interest; n equals average life. These values are obtained by the use of Logarithms.[37]

Wm. Cole Method

The Wm. Cole Method is to add the number of years representing all the years which the machine is assumed to last, which would be in the case given, 12,11,10,9,8,7,6,5,4,3,2, and 1, the sum of which is the denominator of a fraction having for its numerator the number of years remaining as 12/78, 11/78,10/78,9/78 etc.[38] This fraction is not taken upon the \$2000 but upon the \$1800 the total amount of depreciation for the twelve years. The first year the depreciation would be 12/78 of \$1800,which is \$276.92; the second year 11/78 of \$1800,which is \$230.77, etc.; each year the amount of depreciation is 1/78 less than the year before and the last year it would be 1/78 of \$1800,which is \$23.07, so making a total of 78/78 or a total of \$1800 depreciation with a balance of \$200, the estimated scrap value.

This method is also based upon the fact that because the

[37] H. Erickson, Depreciation, -p.34.
[38] Wm. Cole, Accounting and Auditing, -p.271.

machine is new and the cost of repairs low the first few years the amount of depreciation should be large in order to make the charges to operating expense uniform during the life of the machine.

The cost of depreciation by this method ranks second as to high charges the first year, the Diminishing Value Method ranking first, but the 12th year the amount is less by this method or any other method by $18.03. This method is perhaps as near right as any of the others. The result is a uniform fall in the amount of depreciation each year while with the other methods it varies; by the Annuity and Sinking Fund the amount increases but not uniformly, and by the Diminishing Value Method it decreases but not uniformly.

Revaluation Method

The Revaluation Method of providing for depreciation is the hiring of experts in this line of work to estimate how much a machine or factory has depreciated during the year.

The Revaluation Method has been used to a great extent by factories, but it is a very poor method, unless the persons making the valuation are experts in that work. If they are not experts they are liable to be influenced to a great extent by the present market price of each unit, instead of how much it has fallen in exchange value due to wear and tear. Persons making the valuation of a machine or factory as to depreciation should not be influenced by the present market price of the different units, because their work is to find out how much has been lost from wear and tear and not from the fall in the market price; that loss is to be considered if the machine or

factory is purchased by some one, but not in connection with production.

Again, persons who are not experts are liable to be influenced by those in charge of the factory and also as to whether it has been a good or poor year for the factory; if it has been a good year to deduct a large amount for depreciation and if it has been a poor year to cut down the amount for depreciation.

The objections to the Revaluation Methods are that it would require the service of professional men in that line of work and this would mean a very great expense to the factory and not only that, but would cause the factory to close down while the inspection was being made so causing a great loss.[39] The persons making the valuation will not be able to see all the parts of a machine or factory and if they are not experts they will have different opinions in regard to the actual amount of loss caused by wear and tear, so that in two factories which have been operated in almost the same way and under the same conditions there might be quite a difference in the sum charged off to operating expense for depreciation.

For factories that can afford the service of experts the Revaluation Method is among the best and if any of the other methods of providing for depreciation are used, a revaluation of the factory should be made every few years by experts in order to see that the estimated rate of depreciation is correct.

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39. D. S. Kimball, Principles of Industrial Organization, -p.149

Compound Interest Method

The Compound Interest Method as given here is based upon the Straight Line Method. It assumes that the amount to be depreciated each year in the problem given is $150 and that this $150 will bear interest at 5%, so that the second year the total depreciation would be only $142.50, but the amount in the fund would be $300, the interest making up the difference of $7.50. The third year it would be $135, but the total amount in the fund would be $450. Each year the amount of interest from the fund is counted off from the amount of depreciation so making the amount grow less each year, and the twelfth year the amount of depreciation would be $67.50 and the interest received from the fund would be $82.50. This method would do very well for the factories that have a depreciation Reserve Account where the money is left in the business and than charging the business for the use of the money in this account. It would have an advantage over the Sinking Fund Investment Method in that the money is invested in the business and they are able to make 4, 6, or 8 % above the charges of interest upon this money so that they are not losing money upon the depreciation reserve as they would in the Sinking Fund Method, if the business was making large profits.

This method is given here more to show the effects of interest upon depreciation and the value of considering interests than as a method of considering depreciation.

Double Account System

We also give the Double Account System, but it is one that is very seldom used in the United States. It does not make any provision whatever for any deduction ever being made from the original capital expenditures. The idea is that such provision is unnecessary if all expenses in connection with renewals and replacements have been made out of the revenue. It charges revenue not with the original cost of the wasting assets during the term of their life, but with the cost of purchasing equally efficient assets at the expiration of that time.[40]

By this system the balance sheet is generally divided into two parts. The first part shows the capital spent on the fixed assets, which is offset by a corresponding credit of capital brought down on the credit side as working capital and the floating liabilities, while the offset on the debit side is the floating assets.[41]

The belief that the annual charges to revenue account for repairs and renewals kept the plant at its original cost and therefore, made a constant charge to this account is false in that during the first few years of a factory there are few repairs and renewals, so that during this period the profits are overstated because the plant has gradually fallen in exchange value from use, but has not reached a stage where renewals and repairs must be made. When it does reach this stage it causes a heavier charge to

40. L. R. Dicksee, Advanced Accounting, -p.132.
41. W. A. Chase, Auditing and Cost Accounting, -p.105.

revenue than there had been before, so causing an untrue statement of profits because the loss had taken place before this time. It takes several years before the factory reaches the stage where the annual renewals and repairs become constant for each year unless the factory has been built on the piece meal method.[42]

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42. L. R. Dicksee, Advanced Accounting, -p,142.

Section VI

How Depreciation May Be Recorded

This leads to the consideration of the question how depreciation may be recorded upon the books of a factory. If the amount of depreciation for the year is $1500, some would debit the Profit and Loss Account for that amount and credit the Depreciation Account for the like amount. The accounts would then be,

Profit and Loss

1915			
Dec.31	$1500		

Depreciation

		1915	
		Dec.31	$1500

And after the books are closed there would appear only the one account Depreciation and it would appear upon the Balance Sheet on the credit side or would be deducted from the plant or machinery account. If this method is used it is best to use a more explanatory heading than that of Depreciation. The account should be headed either Depreciation upon Machinery or Machinery Depreciation, thus stating what the depreciation is upon.

The above is not considered the best form. A better form is to debit Depreciation on Machinery and credit Machinery Reserve.

Depreciation on Machinery.

1915			
Dec.31	$1500		

Machinery Reserve

		1915	
		Dec.31	$1500

When the books are closed for the year the Depreciation on Machinery Account is closed out to Profit and Loss through Operative Expense, and the Machinery Reserve Account remains as it is and means that there is $1500 reserved for the replacement of machinery when it is needed. But it is not possible to pick out from the assets that sum which makes the $1500. All that is known is that there is $1500 of assets which can be used, or that it is there to be used when needed to buy new machinery in place of that which has been worn out. It may be in cash, notes, accounts, bonds, or any other assets of the firm.

If there were $80,000 assets and the liabilities were as follows $14,500 Notes and Accounts Payable; $60,000 Capital Stock; $1500 Machinery Reserve; $4000 Surplus; the Balance Sheet would be of the following form:

Form # 1. Balance Sheet

Assets	$80,000	Notes and Accounts Payable.	$14,500
		Capital Stock	60,000
		Machinery Reserve	1,500
		Surplus	4,000
	$80,000		$80,000

Again if this firm wishes to have this $1500 set aside in a special machinery Sinking Fund Investment Account, the Balance Sheet would be as follows:

Form # 2. Balance Sheet

Assets	$78,500	Notes and Accounts Payable.	$14,500
		Capital Stock	60,000
		Machinery Reserve	1,500
Machinery Sinking Fund Investment	1,500	Surplus	4,000
	$80,000		$80,000

In this form it is possible to know exactly what asset goes

to make up the fund for the purpose of buying new machinery for that which has become worn out and it is segregated from the other assets which was not so in the first form.

Again the Balance Sheet may be:

Form # 3 Balance Sheet

Assets	$78,000	Notes and Accounts Payable.	$14,500
Machinery		Capital Stock	60,000
Sinking Fund Investment	1,500	Surplus	5,500
	$80,000		$80,000

The value of the second Balance Sheet over that of the third is that the second has the Machinery Reserve and Surplus separated and gives the information that the Machinery Reserve is not intended to be used in the same manner in which the Surplus may be used, for the total surplus may be declared as dividends.

Suppose now that there had not been either a Sinking Fund Investment Account or a Machinery Reserve created and that the surplus was $5500, the total assets were $80,000 and that all of this Surplus is divided up among the stock holders as dividends, the Assets would then be $74,500; Notes and Accounts Payable, $14,500; Capital Stock, $60,000; If the Notes and Accounts Payable were paid then the Assets would stand at $60,000, which would not be a true statement, for the assets have been worn out to the extent of $1,500, and the true value is then $58,500. The $1,500 has been returned to the stock holders in the form of dividends.

The correct method then in hanlding Depreciation upon the books of a company is to have either a Machinery Reserve

or Machinery Reserve and Sinking Fund Investment Account.

There seems to be some confusion in the minds of many people as to the distribution between Reserve and Reserve Fund. It is quite common to find the terms Depreciation Reserve and Depreciation Reserve Fund meaning the same thing and placed on the credit side of the Balance Sheet, so causing confusion as to the actual meaning of the terms. Sinking Fund Invest generally conveys the idea that certain assets have been set aside for some special purpose and that it is an asset which is supposed to be used for some special purpose when needed; it may be bonds purchased which may be converted into cash at any time for the purpose of paying off a loan when it falls due or for the purpose of making renewals of machinery. It is a segregated asset. The term Reserve is generally found on the credity side of the Balance Sheet. It is generally considered withheld dividends or a portion of the surplus held for some special purpose, but no particular item of the total assets can be picked out as off-setting or balancing the account which is found on the credit side. All that is known is that there are more assets than there would have been if this amount had been divided up among the shareholders as dividends.

Section VII

Conclusion

The purpose of this article has been to explain fully what depreciation is, the different classes of depreciation, the different methods of providing for it, and the way it should be recorded upon the book of a factory. We have also shown that it is an operating expense and must be considered as such before the net profits can be given. That a careful study of each unit of a factory must be made in regard to its use, time of repairs, the way each is built, the general care taken, and in fact everything which might have some effect upon the life of the different units.

It is not possible at the present to state which is the best method of providing for depreciation and it will not be possible to do so until complete data have been collected by accountants, enginners, and managers of factories and carefully analyzed and reported upon by them for all units of the various kinds of factories under various conditions. When this has been done it will be a great help not only to those interested in factories but to the public in general. Many records and life tables have been compiled, but they are far from being complete. The main trouble seems to be that the accountants, engineers, and managers have tried to work it out alone.

All factories should make a careful study of depreciation so as to know the most economical method of financing or

providing for it in order to get the best possible results.

In this article we have not attempted to give the rate of depreciation on any piece of property because the different methods would cause such a variety of results. To use the rates given by the different methods a person would have to know all of the conditions under which the machine or plant was used. A few of the rates will be given to show how rates vary as to different units.

Engines from 4% to 12½%

Boilers from 7½% to 20%

Shafting from 5% to 7½%

Molds and patterns from 25% to 33 1/3% on diminishing value

Machinery in general from 5% to 12½%

Autos 25%

Brick buildings from 2% to 5%

Frame buildings from 4% to 10%

Furniture and Fixtures 5% to 12½% on diminishing value

Loose tools should be revalued each year because many are broken and lost each year

It is generally considered best to revalue horses each year because it does not take much time, and it is easier to get the correct value this way than by making an estimate by the use of past records.

Form III

	Diminishing Value Method	Wm. Cole Method	Straight Line Method	Compound Interest Method	Sinking Fund Method	Annuity Method
1:	$350.	$276.92	$150.	$150.	$113.10	$226.68
2:	288.76	253.85	150.	142.50	113.10	226.68
3:	238.22	230.77	150.	135.	113.10	226.68
4:	196.52	207.69	150.	127.50	113.10	226.68
5:	162.14	184.62	150.	120.	113.10	226.68
6:	133.76	161.54	150.	112.50	113.10	226.68
7:	110.36	138.46	150.	105.	113.10	226.68
8:	91.04	115.39	150.	97.50	113.10	226.68
9:	75.02	92.31	150.	90.	113.10	226.68
10:	61.96	69.23	150.	82.50	113.10	226.68
11:	51.12	46.15	150.	75.	113.10	226.68
12:	41.10	23.07	150.	67.50	113.10	226.68
Total	$1800.	1800.	1800.	1305.	1257.20	2720.16
Scrap	200.	200.	200.	200.	200.	200.
Int.				495.	542.80	Less 920.16
	$2000.	2000.	2000.	2000.	2000.	2000.

Rate of depreciation by the Diminishing Value Method is 17½ %. Rate of interest by the Compound Interest and Sinking Methods is 5%. Six per cent interest has been added to the diminishing value of the asset each year by the Annuity Method.

Form IV

	Diminishing Value Method	Wm. Cole Method	Straight Line Method	Sinking Fund Method Interest 5%	Annuity Method 6% Interest on Diminishing Value of Asset
1	$2000	$2000	$2000	$2000	$2000
2	1650	1723.08	1850	1886.90	1893.32
3	1361.24	1469.23	1700	1768.15	1780.24
4	1123.02	1238.46	1550	1643.47	1660.38
5	926.50	1030.77	1400	1512.56	1533.32
6	764.36	846,15	1250	1374.11	1398.64
7	630.60	684.61	1100	1230.79	1255.86
8	520.24	546.15	950	1079.25	1104.52
9	429.20	430.76	800	920.13	944.08
10	354.18	338.45	650	753.05	774.04
11	292.22	269.22	500	577.62	593.76
12	241,10	223.07	350	393.42	401.88
	200.	200.	200.	200.01	200.00

Form V

Depreciation by the Straight Line Method

Machinery Account

Jan.1,1915	Cash	$2000	Dec.31,1915	Depreciation Balance	$ 150 1850
" 1,1916	Balance brot.down	1850	" 31,1916	Depreciation Balance	150 1700
" 1,1917	Balance brot.down	1700	" 31,1917	Depreciation Balance	150 1550
" 1,1918	Balance brot.down	1550	" 31,1918	Depreciation Balance	150 1400
" 1,1919	Balance brot.down	1400	" 31,1919	Depreciation Balance	150 1250
" 1,1920	Balance brot.down	1250	" 31,1920	Depreciation Balance	150 1100
" 1,1921	Balance brot.down	1100	" 31,1921	Depreciation Balance	150 950
" 1,1922	Balance brot.down	950	" 31,1922	Depreciation Balance	150 800
" 1,1923	Balance brot.down	800	" 31,1923	Depreciation Balance	150 650
" 1,1924	Balance brot.down	650	" 31,1924	Depreciation Balance	150 500
" 1,1925	Balance brot.down	500	" 31,1925	Depreciation Balance	150 350
" 1,1926	Balance brot.down	350	" 31,1926	Depreciation Balance	150 200
" 1,1927	Balance brot.down	200			

Form VI

Depreciation by the Sinking Fund Method

Machinery Account

Jan. 1, 1915	Cash	$2000	Dec. 31, 1915	Depreciation Balance	$ 113.10 1886.90
" 1, 1916	Balance	1886.90	" 31, 1916	Depreciation Balance	118.75 1768.15
" 1, 1917	Balance brot.down	1768.15	" 31, 1917	Depreciation Balance	124.68 1643.47
" 1, 1918	Balance brot.down	1643.47	" 31, 1918	Depreciation Balance	130.91 1512.56
" 1, 1919	Balance brot.down	1512.56	" 31, 1919	Depreciation Balance	137.45 1375.11
" 1, 1920	Balance brot.down	1375.11	" 31, 1920	Depreciation Balance	144.32 1230.79
" 1, 1921	Balance brot.down	1230.79	" 31, 1921	Depreciation Balance	151.54 1079.25
" 1, 1922	Balance brot.down	1079.25	" 31, 1922	Depreciation Balance	159.12 920.13
" 1, 1923	Balance brot.down	920.13	" 31, 1923	Depreciation Balance	167.08 753.05
" 1, 1924	Balance brot.down	753.05	" 31, 1924	Depreciation Balance	175.43 577.62
" 1, 1925	Balance brot.down	577.62	" 31, 1925	Depreciation Balance	184.20 393.42
" 1, 1926	Balance brot,down	393.42	" 31, 1926	Depreciation Balance	193.41 200.01
" 1, 1927	Balance brot.down	200.01			

Form VII

Depreciation by the Diminishing Value Method

Machinery Account

Jan.1,1915	Cash	$2000	Dec.31,1915	Depreciation Balance	$ 350. 1650.
" 1,1916	Balance brot.down	1650	" 31,1916	Depreciation Balance	288.76 1361.24
" 1,1917	Balance brot.down	1361.24	" 31,1917	Depreciation Balance	238.22 1123.02
" 1,1918	Balance brot.down	1123.02	" 31,1918	Depreciation Balance	196.52 926.50
" 1,1919	Balance brot.down	926.50	" 31,1919	Depreciation Balance	162.14 764.36
" 1,1920	Balance brot.down	764.36	" 31,1920	Depreciation Balance	133.76 630.60
" 1,1921	Balance brot.down	630.60	" 31,1921	Depreciation Balance	110.36 520.24
" 1,1922	Balance brot.down	520.24	" 31,1922	Depreciation Balance	91.04 429.20
" 1,1923	Balance brot.down	429.20	" 31,1923	Depreciation Balance	75.02 354.18
" 1,1924	Balance brot.down	354.18	" 31,1924	Depreciation Balance	61.96 292.22
" 1,1925	Balance brot.down	292.22	" 31,1925	Depreciation Balance	51.12 241.10
" 1,1926	Balance brot.down	241.10	" 31,1926	Depreciation Balance	41.10 200.00
" 1,1927	Balance brot.down	200.00			

Form VIII

Depreciation by the Annuity Method

Machinery Account

Jan. 1,1915	Cash	$2000.00	D	Depreciation	$ 226.68
Dec.31,1915	Interest	120.00	Dec.31,1915	Balance	1893.32
Jan. 1,1916	Bal.brot.down	1893.32		Depreciation	226.68
Dec.31,1916	Interest	113.60	" 31,1916	Balance	1780.24
Jan. 1,1917	Bal.brot.down	1780.24		Depreciation	226.68
Dec.31,1917	Interest	106.82	" 31,1917	Balance	1660.38
Jan. 1,1918	Bal.brot.down	1660.38		Depreciation	226.68
Dec.31,1918	Interest	99.62	" 31,1918	Balance	1533.32
Jan. 1,1919	Bal.brot.down	1533.32		Depreciation	226.68
Dec.31,1919	Interest	92.00	" 31,1919	Balance	1398.64
Jan. 1,1920	Bal.brot.down	1398.64		Depreciation	226.68
Dec.31,1920	Interest	83.90	" 31,1920	Balance	1255.86
Jan. 1,1921	Bal.brot.down	1255.86		Depreciation	226.68
Dec.31,1921	Interest	75.34	" 31,1921	Balance	1104.52
Jan. 1,1922	Bal.brot.down	1104.52		Depreciation	226.68
Dec.31,1922	Interest	66.24	" 31,1922	Balance	944.08
Jan. 1,1923	Bal.brot.down	944.08		Depreciation	226.68
Dec.31,1923	Interest	56.64	" 31,1923	Balance	774.04
Jan. 1,1924	Bal.brot.down	744.04		Depreciation	226.68
Dec.31,1924	Interest	46.40	" 31,1924	Balance	593.76
Jan. 1,1925	Bal.brot.down	593.76		Depreciation	226.68
Dec.31,1925	Interest	34.80	" 31,1925	Balance	401.88
Jan. 1,1926	Bal.brot.down	401.88		Depreciation	226.68
Dec.31,1926	Interest	24.80	" 31,1926	Balance	200.00
Jan. 1,1927	Bal.brot.down	200.00			

Form IX

Depreciation by the Wm. Cole Method

Machinery Account

				Depreciation	$ 276.92
Jan.1,1915	Cash	$2000	Dec.31,1915	Balance	1723.08
				Depreciation	253.85
" 1,1916	Balance brot.down	1723.08	" 31,1916	Balance	1469.23
				Depreciation	230.77
" 1,1917	Balance brot.down	1469.23	" 31,1917	Balance	1238.46
				Depreciation	207.69
" 1,1918	Balance brot.down	1238.46	" 31,1918	Balance	1030.77
				Depreciation	184.62
" 1,1919	Balance brot.down	1030.77	" 31,1919	Balance	846.15
				Depreciation	161.54
" 1,1920	Balance brot.down	846.15	" 31,1920	Balance	684.15
				Depreciation	138.46
" 1,1921	Balance brot.down	684.61	" 31,1921	Balance	546.15
				Depreciation	115.39
" 1,1922	Balance brot.down	546.15	" 31,1922	Balance	430.76
				Depreciation	92.31
" 1,1923	Balance brot.down	430.76	" 31,1923	Balance	338.45
				Depreciation	69.23
" 1,1924	Balance brot.down	338.45	" 31,1924	Balance	269.22
				Depreciation	46.15
" 1,1925	Balance brot.down	269.22	" 31,1925	Balance	223.07
				Depreciation	23.07
" 1,1926	Balance brot.down	223.07	" 31,1926	Balance	200.00
" 1,1927	Balance brot.down	200.00			

Form X

Depreciation by the Compound Interest Method

Machinery Account

				Depreciation	$ 150.
Jan.1,1915	Cash	$2000.	Dec.31,1915	Balance	1850.
				Depreciation	150.
" 1,1916	Balance brot.down	1850.	" 31,1916	Balance	1700.
				Depreciation	150.
" 1,1917	Balance Brot.down	1700.	" 31,1917	Balance	1550.
				Depreciation	150.
" 1,1918	Balance brot.down	1550.	" 31,1918	Balance	1400.
				Depreciation	150.
" 1,1919	Balance brot.down	1400.	" 31,1919	Balance	1250.
				Depreciation	150.
" 1,1920	Balance brot.down	1250.	" 31,1920	Balance	1100.
				Depreciation	150.
" 1,1921	Balance brot.down	1100.	" 31,1921	Balance	950.
				Depreciation	150.
" 1,1922	Balance brot.down	950.	" 31,1922	Balance	800.
				Depreciation	150.
" 1,1923	Balance brot.down	800.	" 31,1923	Balance	650.
				Depreciation	150.
" 1,1924	Balance brot.down	650.	" 31,1924	Balance	500.
				Depreciation	150.
" 1,1925	Balance brot.down	500.	" 31,1925	Balance	350.
				Depreciation	150.
" 1,1926	Balance brot.down	350.	" 31,1926	Balance	200.
" 1,1927	Balance brot.down	200.			

Form three shows how the actual amounts vary which are charged off each year to operating expense for depreciation by the different methods upon a machine which cost $2000 new, the estimated life being twelve years and the scrap value $200.

Form four shows the value of the machine each year if the depreciation is deducted, and how by the different methods the value of the machine varies. The Compound Interest Method is not given as the results would be the same as those of the Straight Line Method. The Revaluation Method results cannot be given because they are ascertained by means of a personal inspection by an expert.

Forms five, six, seven, eight, nine, and ten are given so that the different methods of providing for depreciation may be better understood, and to show how the Machinery Account would appear if the depreciation were entered each year to that account instead of to the Machinery Reserve Account. It must be remembered that these forms are not the proper methods of recording depreciation as was shown before in this article. It is best to open a Reserve Account to which the provision for depreciation is credited, and then in the Balance Sheet the credit balance of this account should be deducted from the asset against which the reserve is being accumulated. Very often when the Reserve Account is placed on the credit side of the Balance Sheet, it might be supposed that the balance of the Reserve Account represented undivided profits.[43] It is never best to

[43] L. R. Dicksee, Advanced Accounting, -p. 256.

enter the reserve on machinery in the books as Reserve Account, it is always preferable to state what the reserve is for. If it is for machinery it should be entered as Machinery Reserve Account.

BIBLIOGRAPHY and REFERENCES.

American Economic Association. Federal Census. New Series Vol. II New York, 1899.

Bentley, H. C. Science of Accounts. New York 1911.

Brisco, E. Economics of Business. New York, 1913.

Bunnell, S. H. Cost-Keeping for Manufacturing Plants. New York, 1912.

Business Mens Library, Cost of Production. Chicago, New York, London, 1913.

Chase, W. A. Auditing and Cost Accounting. Chicago, 1911.

Charlton, W. H. American Mine Accounting. New York 1913.

Cleveland and Powell. Railraod Finance. New York, 1912.

Cole, Wm. Accounting and Auditing. Minneapolis, Chicago, 1910.

Cyclopedia of Commerce Accountancy. Business Administration, Vol. VI, Chicago, 1910.

Dawson, S. S. Accountants Compendium. London, 1908.

Dickinson, A. L. Accounting Practice and Procedure. New York, 1914.

Dicksee, L. R. Depreciation, Reserves and Reserve Funds. London, 1907.

Dicksee, L. R. Advanced Accounting. London, 1907.

Dicksee and Blain. Office Organization and Management. London, 1911.

Diemer, H. Factory Organization and Administration. New York, 1910.

Dowler and Harris. Auditing, Accounting and Banking. London, 1912.

Eddis, W. C. Manual of Accounting. Toronto, 1899.

Elbourne, E. T. Factory Administration and Accounts. London, 1914.

Ennis, W. D. Works Management. New York, 1911.

Erickson, H. Depreciation. Address delivered before Convention of Central Water Works Association. Detroit, Michigan, 1912.

Erickson, H. Valuation of Public Utilities. Address before the Indiana Sanitary and Water Supply Association. February 15, 1912.

Evans, H. Cost-Keeping and Scientific Management. New York, 1911

Floy, H. Valuation of Public Utilities. New York, 1912

Foster, H. A. Engineering Valuation of Public Utilities and Factories. New York, 1912.

Garcke and Fells, Factory Accounts. London, 1911

Going, C. B. Principles of Industrial Engineering. New York, 1911

Goldman, H. Cyclopedia of Business. Cincinnati, Ohio, 1911

Greendlinger, L. Accountancy Problems. New York, 1909-1911

Hatfield, H. R. Modern Accounting. New York, 1909

Hayes, H. V. Public Utilities, Their Cost New and Depreciation. New York, 1913.

Hoxie, G. L. Some Features of Rate Fixing for Electric Public Service Properties. New York, 1912

Johnson, G. Manufacture Bookkeeping and Costs. New York, 1913

Keister, D. A. Corporation Accounting and Auditing. Cleveland, Ohio, 1901

Kimball, D. S. Principles of Industrial Organization. New York, 1913

Leake, P. D. Depreciation and Wasting Assets. London, 1912

Lisle, Geo. Accountancy in Theory and Practice. Edinburgh, 1903

Lisle, Geo. Encyclopedia of Accounting. Vol. II, London, 1903

Matheson, E. Depreciation of Factories. London, 1884

Meade, E. S. Corporation Finance. New York, 1910

Mead, D. W. Arbitration or Appraisal of the Values of Public Utilities. Chicago, 1912

Montgomery, R. H. Auditing, Theory and Practice. New York, 1912

Nash, L. R. Valuation of Public Service Properties. Boston, 1912

Nicholson, J. L. Factory Organization and Costs. New York, 1909

Nixon and Stagg. Accounting and Banking. London, New York, 1907

Pixley, F. W. Auditors, Their Duties and Responsibilities. London, 1906

Racine, S. F. Accounting Principles. Seattle, 1913

Slater, J. A. (Editor) Pitman's Encyclopedia, London

Thorne, W. W. (Editor) American Business and Accounting Encyclopedia. Detroit, 1908-1909

Walton and Gilman, Auditing and Cost Accounts. New York, 1913

Webner, F. E. Factory Costs. New York, 1913

Whitten, R. H. Valuation of Public Service Corporations New York, 1912

Wyer, S. S. Regulation, Valuation and Depreciation of Public Utilities. Columbus, Ohio, 1913

Accountant, London, Dec. 27, 1913

Annals of the American Academy of Political and Social Science. Philadelphia, May, 1914

Cassier, New York. July 1905. Feb., 1909. Sept. and Nov. 1912

Economic Journal. New York, March 1904

Electrical World. New York, Feb.25, Aug.26,1909. Aug.5,1911

Engineers' News. New York, March 1909. May 8,1913

Gas Age. New York, August 1, 1914

Iron Age. New York, March 5, May 14 and 28, 1914

Journal of Accounting. New York, Dec. 1906. May 1907. Jan. and Aug. 1908. Octo. and Dec. 1909. Feb. and Nov. 1913. Jan. and April 1914.

Journal of Political Economy, Chicago, Nov. 1908. April 1909. Jan. 1915

Power, New York. May 4,1889. March 17,1908. June 8, 1909. April 8, 1913. June 2, 1914.

Public Service. Chicago. August 1909. March 1910. March, April, Sept. and October 1911. March, July, October and November, 1913.

Quarterly Journal of Economics. Boston, August 1914. February 1915

Railway Age. Chicago, May 10, 1907. April 17, May 1, July 3, 1908. May 30, June 20, August 15, 1913.

Wisconsin Railroad Commission Reports. Vol. 1, 2, 3, 4, 5.

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